

## WHAT IS CLAIMED IS:

1. A semiconductor laser device wherein an n-type  $(Al_eGa_{1-e})_fIn_{1-f}P$  ( $0 \leq e \leq 1$ ,  $0 \leq f \leq 1$ ) cladding layer, an active layer comprising a plurality of stacked layers of AlGaInP type material, a p-type  $(Al_xGa_{1-x})_yIn_{1-y}P$  ( $0 \leq x \leq 1$ ,  $0 \leq y \leq 1$ ) cladding layer, and a p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  ( $0 \leq p \leq x$ ,  $0 \leq q \leq 1$ ) intermediate band gap layer are stacked in this order on a substrate, the semiconductor laser device having a current injection region and a current non-injection region,

10 wherein the semiconductor laser device further comprises:

an oxide layer formed on a surface of the p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  intermediate band gap layer in the current non-injection region;

15 a p-type  $Al_uGa_{1-u}As$  ( $0 \leq u \leq 1$ ) cap layer formed on the p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  intermediate band gap layer in the current injection region; and

a p-type  $Al_vGa_{1-v}As$  ( $0 \leq v \leq 1$ ) contact layer formed on the oxide layer and the p-type  $Al_uGa_{1-u}As$  cap layer.

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2. The semiconductor laser device according to claim 1, wherein the oxide layer has an oxygen concentration that is higher than an oxygen concentration at an interface between the p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  intermediate band gap 25 layer in the current injection region and the p-type

(Al<sub>u</sub>Ga<sub>1-u</sub>)As cap layer and that is also higher than an oxygen concentration at an interface between the p-type (Al<sub>u</sub>Ga<sub>1-u</sub>)As cap layer and the p-type Al<sub>v</sub>Ga<sub>1-v</sub>As contact layer.

5       3. The semiconductor laser device according to claim 1, wherein the oxide layer has an oxygen concentration of 1 x 10<sup>20</sup> cm<sup>-3</sup> or more.

10      4. The semiconductor laser device according to claim 1, wherein an oxygen concentration at an interface between the p-type (Al<sub>p</sub>Ga<sub>1-p</sub>)<sub>q</sub>In<sub>1-q</sub>P intermediate band gap layer in the current injection region and the p-type (Al<sub>u</sub>Ga<sub>1-u</sub>)As cap layer, and an oxygen concentration at an interface between the p-type (Al<sub>u</sub>Ga<sub>1-u</sub>)As cap layer and the p-type Al<sub>v</sub>Ga<sub>1-v</sub>As contact layer are not more than 10 x 10<sup>19</sup> cm<sup>-3</sup>.

15      5. The semiconductor laser device according to claim 1, wherein the p-type (Al<sub>p</sub>Ga<sub>1-p</sub>)<sub>q</sub>In<sub>1-q</sub>P intermediate band gap layer satisfies a condition of 0 < p ≤ 0.1.

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6. The semiconductor laser device according to claim 1, wherein the current non-injection region is located closer to a laser-beam emitting end face than the current injection region is.

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7. The semiconductor laser device according to claim 6, wherein a region of the active layer corresponding to the current non-injection region is intermixed at least at a portion on the side of the laser beam-emitting end face.

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8. A method for producing the semiconductor laser device of claim 1, comprising:

an intermediate band gap layer and cap layer forming process that sequentially forms a p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  ( $0 \leq p \leq x$ ,  $0 \leq q \leq 1$ ) intermediate band gap layer and a p-type  $(Al_uGa_{1-u})As$  ( $0 \leq u \leq 1$ ) cap layer in a film-forming apparatus;

a cap layer removing process that, after performing the intermediate band gap layer and cap layer forming process, partially removes the p-type  $(Al_uGa_{1-u})As$  cap layer in order to form a current non-injection region;

an oxide layer forming process that forms an oxide layer at a surface of the p-type  $(Al_pGa_{1-p})_qIn_{1-q}P$  intermediate band gap layer exposed due to the partial removal of the p-type  $(Al_uGa_{1-u})As$  ( $0 \leq u \leq 1$ ) cap layer in the cap layer removing process; and

a contact layer forming process that forms a p-type  $Al_vGa_{1-v}As$  ( $0 \leq v \leq 1$ ) contact layer on the p-type  $(Al_uGa_{1-u})As$  cap layer remaining without being removed in the cap

layer removing process and on the oxide layer formed in the oxide layer forming process.

9. The method for producing the semiconductor laser device according to claim 8, wherein the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer is formed by molecular beam epitaxy.

10. The method for producing the semiconductor laser device according to claim 9, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized using a solution containing hydrogen peroxide.

11. The method for producing the semiconductor laser device according to claim 9, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized by being exposed to an atmosphere of at least one of ozone, oxygen ion or activated oxygen.

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12. The method for producing the semiconductor laser device according to claim 9, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized by being exposed to a gas containing water vapor.

13. The method for producing the semiconductor laser device according to claim 8, wherein the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer is formed by metal-organic chemical vapor deposition method.

14. The method for producing the semiconductor laser device according to claim 13, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized using a solution containing hydrogen peroxide.

15. The method for producing the semiconductor laser device according to claim 13, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized by being exposed to an atmosphere of at least one of ozone, oxygen ion or activated oxygen.

20        16. The method for producing the semiconductor laser device according to claim 13, wherein, before forming the p-type  $\text{Al}_v\text{Ga}_{1-v}\text{As}$  contact layer, the surface of the p-type  $(\text{Al}_p\text{Ga}_{1-p})_q\text{In}_{1-q}\text{P}$  intermediate band gap layer is oxidized by being exposed to a gas containing water vapor.